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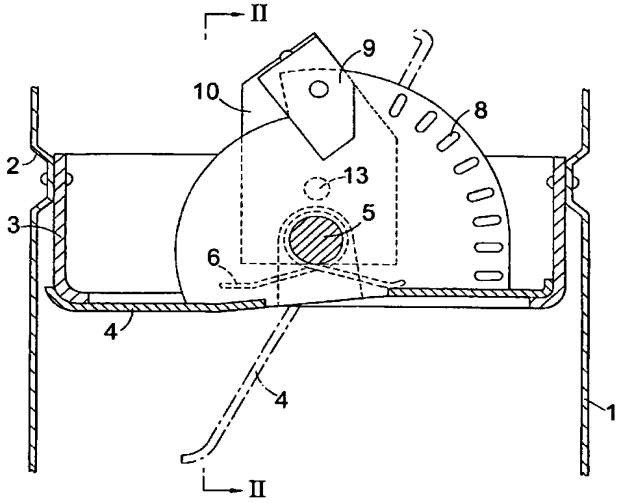
(54) Title: THERMALLY-ACTUATED CARTRIDGE AND FIRE DAMPER



(57) Abstract: A thermally-actuated cartridge (21) has a center pin (24) which is arranged to protrude through the rear of a cartridge holder (23) when the cartridge assembly (21) is not set, so that it is apparent that the cartridge assembly (21) is not set. In a fire damper for an airflow duct, the cartridge assembly (21) is used as a detent to hold a damper flap (7) open. There is a particularly convenient way of mounting the detent arrangement by having a U-shaped member (9) which carries a limb (15) acting as a backing piece for a retention quadrant (7) and a sprung bracket (16) which are squeezed together by the cartridge assembly (21). The U-shaped member (9) is mounted by a means of a limb extension (10) which slots over the damper flap axle (5) and is held by a rivet (13) in the correct orientation, the cartridge assembly (21) being screwed through a threaded bore formed by upsetting or swaging a limb (14) of the U-member (9) through a hole in the extension (10).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Thermally-Actuated Cartridge and Fire Damper

Background of the Invention

The present invention relates generally to thermally-actuated cartridges for fire dampers for airflow ducts, but also relates more generally to any thermally-actuated mechanism and any damper for airflow ducts.

WO 02/43810 and EP0 300992 disclose the use of thermal cartridges for closing the damper element of a fire damper in an airflow duct. There can be problems with the cartridge if it is wrongly installed. For instance, if it is screwed in too tightly, the solder (or other heat-softenable or meltable material) can rupture, but there is no indication that this has occurred so that if there is a fire, the damper element does not close.

The installation of a member for carrying the cartridge and arranging for the retention of the damper element can give significant difficulty.

The Invention

The present invention provides a thermally-actuated cartridge as set forth in Claim 1 or 13, a thermally-actuated mechanism as set forth in Claim 14 and a damper as set forth in Claim 18, 31 or 42, as well as the airflow insulation of Claim 43. The remaining Claims set forth preferred or optional features of the invention.

In Claim 1, the movable member protrudes through the opening when the cartridge is triggered. This has the advantage of indicating externally that an excessive temperature has been reached. However, there is also the advantage that if the cartridge is say screwed in too hard, and the solder ruptured, it is apparent from outside that the mechanism would be inoperative. In effect, the invention provides fail-safe operation. There is also the advantage that the protruding end portion of the movable member can be arranged to actuate a microswitch, which can give a warning signal.

Preferably the arrangement is such that when the cartridge or mechanism is set, the movable member does not protrude at all or substantially through the opening, the end of the movable member preferably being flush with the opening. In this way, a protruding end gives a clear signal that the cartridge or mechanism is not set. However, if the end of the movable member protrudes when the cartridge or mechanism is set, the end portion can be profiled or marked so that its movement is apparent.

The difficulty of installation can be avoided using the damper of Claim 31. The U-shaped member is easily installed in that the second limb can be engaged over the damper element axle to locate the U-shaped member and then the U-shaped member firmly fixed using the securing means to secure the second limb to the inner circumferential wall of the ducting.

Preferred Embodiment

The invention will be further described, by way of example, with reference to the accompanying drawings, in which:

Figure 1 is a part longitudinal section through a section of airflow ducting which forms a fire damper;

Figure 2 is a part longitudinal section along the plane II-II in Figure 1;

Figure 3 is an enlarged part-longitudinal section through the thermal cartridge shown in Figure 2, in the set configuration;

Figure 4 corresponds to Figure 3, but shows the cartridge when it has triggered;

Figure 5 shows the right-hand end of the U-shaped member (as seen looking in Figure 2), in section along the plane V-V indicated in Figure 2;

Figure 6 is a view of the end limb of Figure 5 looking in the direction of the arrow VI in Figure 5; and

Figure 7 is a section of the end limb taken along the line VII-VII in Figure 5.

Figures 1 and 2 show ducting 1 for for instance an air-conditioning installation. A damper is provided by swaging the ducting 1 inwards at 2, riveting a cylindrical rim 3 to the swaged-in part 2 and pivoting a damper element or flap 4 on a transverse axle 5. In the closed position shown in full lines in Figure 1, the periphery of the flap 4 bears

against the rim 3, effectively to close the duct. The fully open position of the flap 4 is indicated in chain-dotted lines in Figure 2. At the sides, the flap 4 is suitably cut away, generally as illustrated in WO 02/43810. Two helical springs 6 bias the flap 4 into its closed position.

A generally sector-shaped retention member or quadrant 7 is held in a slot in the flap 4 and secured by the axle 5 which passes through a hole in the quadrant 7 so that the quadrant 7 is fixed relative to the flap 4. The quadrant 7 has a series of cut-outs or notches 8 adjacent its periphery.

A U-shaped support member 9 is mounted in position in the following manner. The U-shaped support member 9 has at right angles thereto a profiled limb extension 10 which has a notch 11 in its lower end (see Figure 5) which locates over the axle 5 and has a bore 12 by which the extension 10 is secured to the inner circumference of the ducting 1 at the swaging 2 by securing means in the form of a rivet 13 (see Figure 2). The notch 5 ensures that the limb extension 10 is correctly aligned. The limb 14 of the support member 9 which is nearer the wall of the ducting 1 is swaged onto the end of the extension 10, as shown in Figure 2, thus fixing the limb extension 10 to the support member 9. The swaging is taken through a circular bore in the limb extension 10, and is tapped with a female thread. As can be seen in Figure 2, the extension 2 is suitably profiled. The part adjacent the axle 5 is curved to mate properly with the rim 3 (see Figure 6) and there is a small side flange 10a to engage the edge of the limb 14 (see Figure 7).

The other limb 15 of the support member 9 is internally of the quadrant 7. Externally of the quadrant 7, a sprung L-bracket 16 is riveted to the base 17 of the support member 9. The bracket 16 has pressed in it a dimple 18 which is roughly the same size as the cut-outs in the quadrant 7 and which, in the set position of the damper, engages in a cut-out 8.

A cartridge assembly 21 is passed through a hole in the ducting 1 and screwed into the tapped swaging of the limb 14, being held in place by a lock-nut 22. Though not shown, the lock-nut 22 is screwed up until the wall of the ducting 1 firmly abuts the

swaging of the limb 14, the wall deforming to permit this. The cartridge assembly 21 is formed of a body member or cartridge holder 23 (see Figures 3 and 4) having a central bore accommodating a movable member in the form of a rod or pin 24 and a counter bore accommodating an O-ring 25 and a plastic sleeve 26. The O-ring 25 applies friction to the pin 24 and holds it in the assembly 21 (as an alternative, or in addition, ears can be formed on the pin 24 by swaging, to the left of the O-ring 25, as looking in Figure 2). The end of the pin 24 does not protrude substantially through the external opening in the holder 23, and the end of the pin 24 is preferably flush with the end face of the holder 23. The cartridge proper, in the form of a cylindrical casing 27, is pressed into and held by the sleeve 26. On the end of the casing 27 there is a detent body or claw holder 28 which has an actuating member or head in the form of a short end cap 29 (see Figure 2) carrying two elongate detents or claws 30. The claws have inturned ends which engage in an annular groove 31 in the casing 27. The claws 30 have circular openings 32 near their roots, to make them less rigid, and adjacent each opening 32 a heat-softenable or meltable (fusible) material in the form of solder 33 is applied so that it adheres both to the claws 30 and to the outside of the casing 27. As the force on the ends of the claws is always in a radial direction before the solder 33 melts, the solder 33 is under tension.

In order to set the fire damper, the flap 4 is opened using a key and is held at a suitable inclination. The cartridge assembly 21 is then screwed in and the flap 4 positioned so that the dimple 18 engages in a cut-out 8. The end cap 29 should abut firmly against the spring bracket 16, which acts as an engaging member, pressing the quadrant 7 against the limb 15, which then acts as a backing piece, thereby securing the quadrant 7 and holding the flap 4 in an open position. The lock nut 22 is applied.

If the temperature rises excessively, the solder 33 melts. The springs 6 are sufficiently strong to cam the dimple 18 out of the cut-out 8, pushing the claw holder 28 to the right as shown in Figure 3 and camming the ends of the claws 30 out of the groove 31 (in a radial direction) so that the configuration is as shown in Figure 4. The movement of the claw holder 28 causes the pin 24 to move to the right (as shown in Figure 4) and its end now protrudes from the cartridge holder 23. This indicates that the

cartridge assembly 21 is no longer set. If desired, a microswitch 34 can be mounted so as to be actuated by the pin 24, to give a signal.

In a variation of the arrangement, not illustrated, there is no thermal cartridge as such. The O-ring 25 is replaced by a disc and the rod 24 suitably shortened and the casing 27 is arranged so as to abut directly on the spring bracket 16. The rod 24 is connected to a solenoid which, when energised, applies a constant force on the rod 24, urging it to the left in Figure 3 and holding the flap 4 open. For adjustment or on an excessive temperature rise, the solenoid is de-energised, the rod 24 moves to the right and the flap 4 is freed.

In a further variation, not illustrated, where the thermal cartridge is not wanted, the same basic arrangement can be used. It would be possible to use a dummy cartridge with equivalent proportions, but in practice, the cartridge is omitted and a longer pin 24 is used. The left-hand end of the pin engages in the dimple 18 and the right-hand end of the pin 24 can be acted on by say a solenoid. In this case, as the right-hand end of the pin 24 will protrude all the time, it can have steps formed in it or can be marked with say red paint to give an indication whether the arrangement is set or not. If as in yet a further variation, the spring bracket 16 is omitted, the pin 24 can act both as the moving member and as the engaging member and engage in one of the cut-outs 8.

Example

In one preferred example, the following components were used:
Spring bracket 16 – spring quality stainless steel;
U-member 9 – plated mild steel;
Casing 27 – 7 mm diameter, brass;
Claw holder 28 – brass;
Cartridge holder 23 – mild steel, plated;
O-ring 25 – neoprene;
Plastic sleeve 26 – PVC;
Solder – melting point preferably 72°C, but according to installation requirements, up to 102°C;

Centre bore in cartridge holder 23 – nominal 4 mm;

Pin 24 – nominal 4 mm, stainless steel;

Movement of claw holder 28 – 2 mm;

Diameter of cartridge holder 23 – 12.5 mm;

Depth of swaging 2 - 2.5 mm.

* * * * *

Unless the context clearly requires otherwise, throughout the description and the Claims, the words "comprise" and the like are used in an inclusive as opposed to an exclusive or exhaustive sense, that is to say, in the sense of "include, but not limited to".

The present invention has been described above purely by way of example, and modifications can be made within the spirit of the invention. The invention also consists in any individual features described or implicit herein or shown or implicit in the drawings or any combination of any such features or any generalisation of any such features or combination. Each feature disclosed in the specification, including the Claims, abstract and drawings, may be replaced by alternative features serving the same, equivalent or similar purposes, unless expressly stated otherwise.

CLAIMS:

1. A thermally-actuated cartridge having:

a temperature-sensitive element;

a movable member associated with the temperature-sensitive element and which moves when the temperature-sensitive element reaches a certain temperature; and

a body surrounding the movable member and having an external opening through which the movable member can protrude;

the arrangement being such that when the temperature-sensitive element reaches said certain temperature, the movable member moves and protrudes or protrudes further through the opening.

2. The cartridge of Claim 1, wherein the movable member is an axially-movable rod.

3. The cartridge of Claim 2, wherein the body comprises a cylindrical casing mounted by a mounting member, said opening being in the mounting member.

4. The cartridge of any of the preceding Claims, wherein the body is extended, the temperature-sensitive element being adjacent one end of the body and the opening being adjacent the other end of the body.

5. The cartridge of Claim 4, wherein the casing is an elongate cylinder and the mounting member is cylindrical with a bore in one end receiving an end portion of the cylinder, said opening being at the other end.

6. The cartridge of any of the preceding Claims, wherein the temperature-sensitive element comprises a heat-softenable or meltable material which when hard prevents movement of the movable member and when soft or molten permits movement of the movable member.

7. The cartridge of any of the preceding Claims, and comprising a head and a casing, the temperature-sensitive element being such that the head can move relative to

the casing when said certain temperature is reached, the movable member being in contact with or being contactable by the head when the head moves so that the movement of the head causes the movable member to move and protrude or protrude further through said opening.

8. The cartridge of both Claim 6 and Claim 7, wherein the casing has a recess, the movable member is within the casing, and the head has a detent engaging in the recess such that force on the head in the direction of its movement with respect to the casing would cam the detent out of the recess in a direction generally at right angles to the direction of movement of the head and release the head, thereby causing the movable member to move, the heat-softenable or meltable material being between the detent and the casing and being such that said force applies a force on the heat-softenable or meltable material generally at right angles to the direction of movement of the head.

9. The cartridge of Claim 8, wherein the heat-softenable or meltable material is in tension under the action of said force on the head.

10. The cartridge of Claim 9, wherein the head comprises an end piece which is adjacent or abuts the end of the movable member, the end piece having elongate detents which extend outside the casing and parallel to the movable member.

11. The cartridge of any of the preceding Claims, and containing no spring, the cartridge being for a mechanism in which an external force is applied to the cartridge so that the cartridge actuates when the thermo-sensitive element reaches said certain temperature.

12. The cartridge of any of Claims 1 to 10, and containing a spring which causes the movable member to move when the temperature-sensitive element reaches said certain temperature.

13. A thermally-actuated cartridge, substantially as herein described with reference to the accompanying drawings.

14. A thermally-actuated mechanism, comprising:

a movable operative member which can move between a first position and a second position;

means biasing the operative member into the first position; and

a thermally-actuated cartridge for retaining the operative member in the second position, against the biasing of the biasing means, the cartridge comprising:

a temperature-sensitive element;

a head associated with the temperature-sensitive element, for movement when the temperature-sensitive element reaches a certain temperature to thereby release the operative member;

a movable member which is caused to move when the head moves; and

a body surrounding the movable member and having an external opening through which the movable member can protrude;

the arrangement being such that when the thermally-sensitive element reaches said certain temperature, the movable member moves and protrudes or protrudes further through the opening.

15. The mechanism of Claim 14, wherein the cartridge is as in any of Claims 1 to 13.

16. The mechanism of Claim 14 or 15, wherein the protruding movable member actuates a microswitch.

17. The mechanism of any of Claims 14 to 16, and being a fire damper for an air flow duct, the operative member being a damper flap which is pivotally mounted for movement from said second position allowing air to flow along the duct to said first position substantially preventing air flowing along the duct.

18. A damper for an air flow duct comprising:

ducting;

a damper element in the ducting and movable between a first, closed position and a second, open position;

biasing means biasing the damper element into its closed position; and

retention means for retaining the damper element in an open position;

the retention means comprising:

an actuating member;

a retention member which is fixed relative to the damper element and can be secured by the action of the actuating member to retain the damper element in an open position, which securing can be released by movement of the actuating member to release the damper element so that the latter is moved by the biasing means into its closed position;

a body member which is fixed to an opening in the circumferential wall of the ducting and has a through-hole which passes from the exterior to the interior of the body member; and

a movable member in the through-hole and arranged so that it moves when the actuating member moves, the movable member being arranged such that it protrudes or protrudes further from the exterior of the body member when it moves to release the damper element.

19. The damper of Claim 18, and comprising a fixed backing piece on the other side of the retention member to the movable member so that the movable member can press the retention member against the backing piece.

20. The damper of Claim 18, and comprising a sprung piece fixed to the ducting and acting as the engaging member such that the movable member can engage the sprung piece to press the sprung piece against the retention member.

21. The damper of any of Claims 18 to 20, wherein the damper element is rotatably mounted for movement between its closed position and an open position, and the retention member is generally sector shaped.

22. The damper of any of Claims 18 to 21, wherein the retention member has a number of recesses or cut-outs for engagement directly or indirectly by the actuating member, to provide a number of different open positions of the damper element, of various degrees of opening, a camming arrangement being provided so that the respective recess or cut-out will cease to be engaged and the damper element will move

into its closed position when the actuating member exerts no pressure on the retention member.

23. The damper of any of Claims 18 to 22, wherein the protruding end portion of the movable member actuates a microswitch.

24. The damper of any of Claims 18 to 22, wherein the body member mounts a thermally-actuated assembly for releasing the retention member if a certain temperature is reached.

25. The damper of Claim 24, wherein the body member and movable member are comprised in the cartridge of any of Claims 1 to 13.

26. The damper of Claim 24, wherein the thermally-actuated assembly is in the form of a removable cartridge, or of Claim 25 wherein the cartridge is removable.

27. The damper of Claim 26, modified in that there is no thermally-actuated assembly, the cartridge not being present, the retention member being releasable by acting externally on said movable member.

28. The damper of any of Claims 18 to 26, wherein the retention member is releasable by acting externally on said movable member.

29. The damper of Claim 28, wherein the movable member is biased inwards by external biasing means which can be released to release the retention member.

30. The damper of Claim 29, wherein the external biasing means is a solenoid.

31. A damper for an air flow duct comprising:

ducting;

a rotary damper element carried on an axle in the ducting and movable between a closed position and an open position;

biasing means biasing the damper element into its closed position; and

retention means retaining the damper element in an open position;

the retention means comprising:

an actuating member;

a retention member which is fixed relative to the damper element and is secured by the action of the actuating member to retain the damper element in an open position, which securing can be released to release the damper element so that it is moved by the biasing means into its closed position; and

a support member fixed to the circumferential wall of the ducting and supporting at least part of the retention means, the support member having a base and at least a first limb, at a substantial angle to the base, which limb is adjacent the inner circumferential wall of the ducting and has a notch on its open end passing over the damper element axle; and

securing means securing the limb to the inner circumferential wall of the ducting at a position between the axle and the base of the support member.

32. The damper of Claim 31, wherein the support member has a further limb on the opposite side of the retention member to the actuating member, which further limb acts as a backing piece.

33. The damper of Claim 31, wherein the support member has a further limb in the form of a sprung piece on the same side of the retention member as the actuating member, which sprung piece is pressed against the retention member by the actuating member when the damper flap is retained in an open position.

34. The damper of both Claim 32 and Claim 33, whereby when the damper flap is retained in an open position, the actuating member presses the sprung piece against the retention member which in turn is pressed against the backing piece.

35. The damper of any of Claims 31 to 34, wherein the first limb of the support member is formed as an initially separate extension piece which is secured to the remainder of the support member.

36. The damper of any of Claims 31 to 35, wherein the retention means comprise a body member which is fixed to an opening in the circumferential wall of the ducting and which carries the actuating member.

37. The damper of Claim 36, wherein there is a tapped hole through said first limb adjacent the base of the support member, into which hole is screwed the body member.

38. The damper of any of Claims 31 to 37, wherein the actuating member forms part of a thermally-actuated assembly for releasing the retention member if a certain temperature is reached.

39. The damper of Claim 38, wherein the actuating member is comprised in the cartridge of any of Claims 1 to 13.

40. The damper of any of Claims 31 to 37, and including means externally of the ducting for acting on the actuating member to release the retention member.

41. The damper of any of Claims 31 to 40 and being also as in any of Claims 18 to 30.

42. A damper, substantially as herein described with reference to the accompanying drawings.

43. An airflow installation comprising the mechanism of Claim 14 or the fire damper of any of Claims 18, 31 or 42.

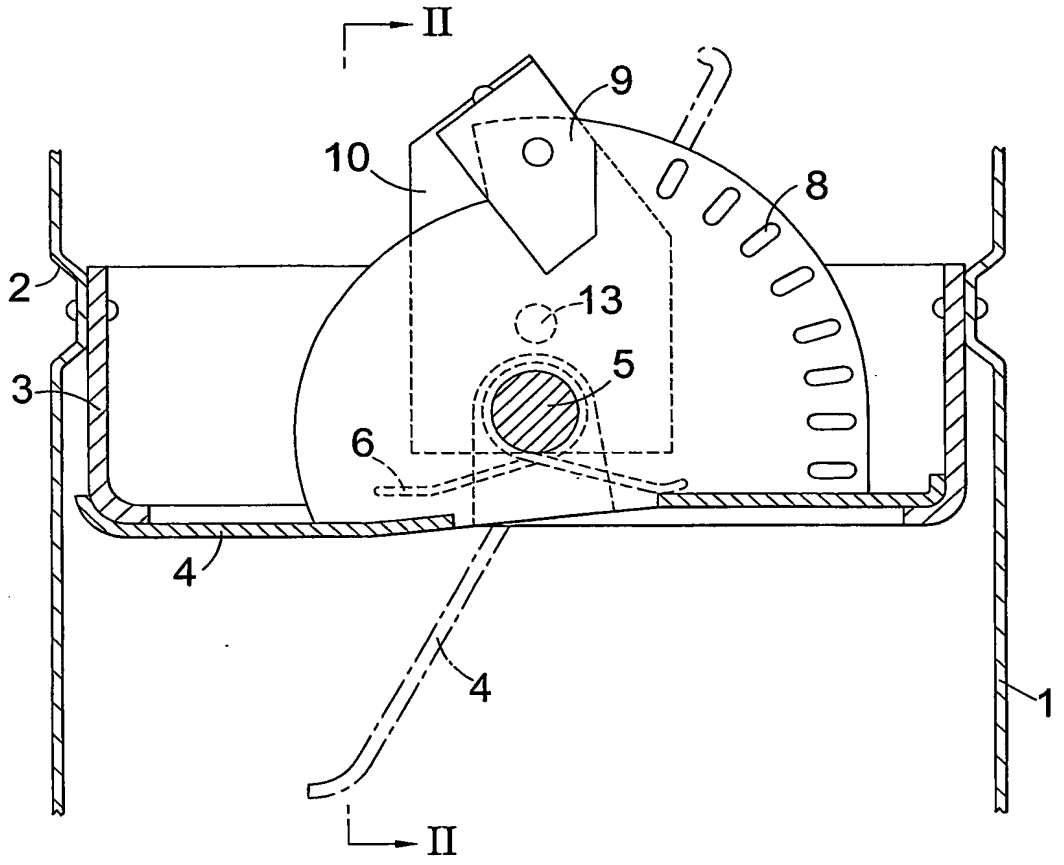

Fig. 1

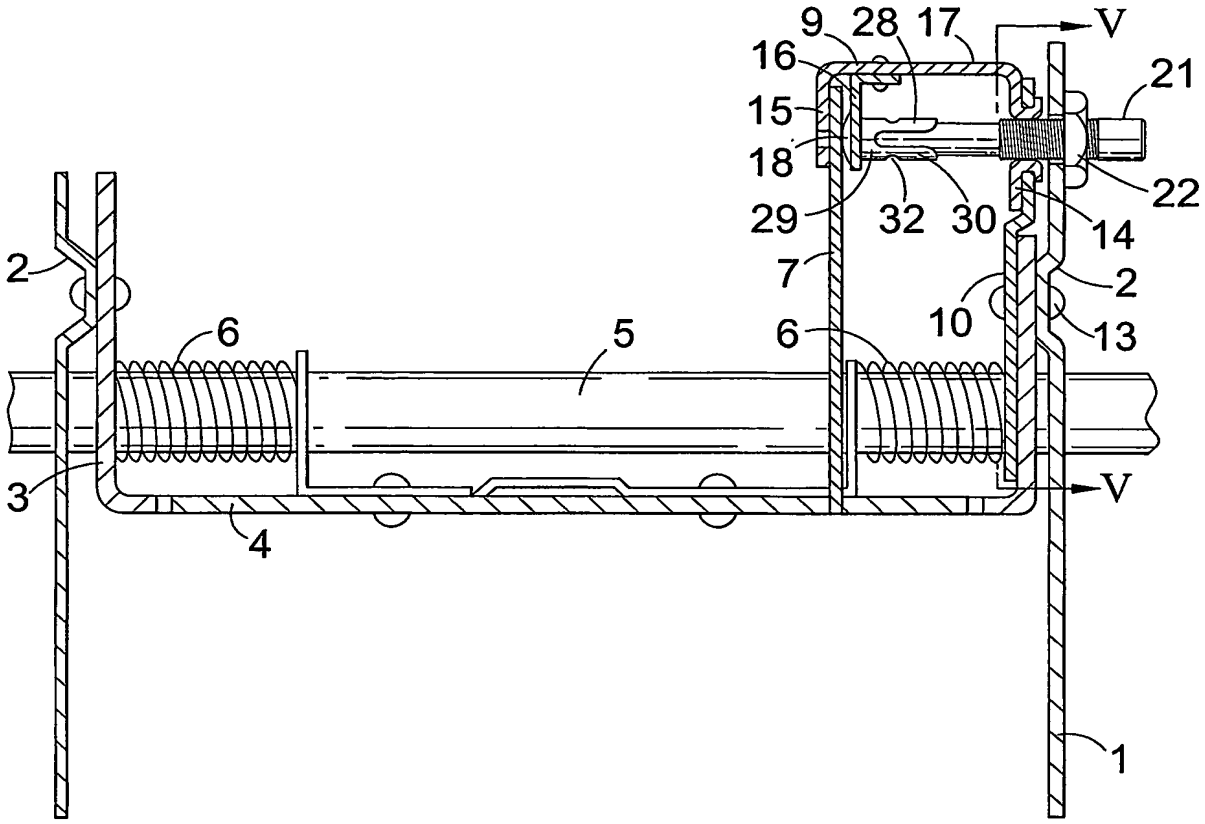

Fig. 2

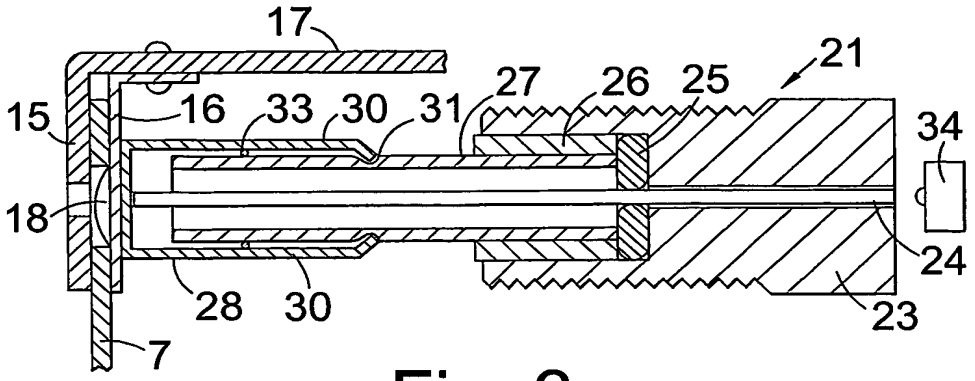

Fig. 3

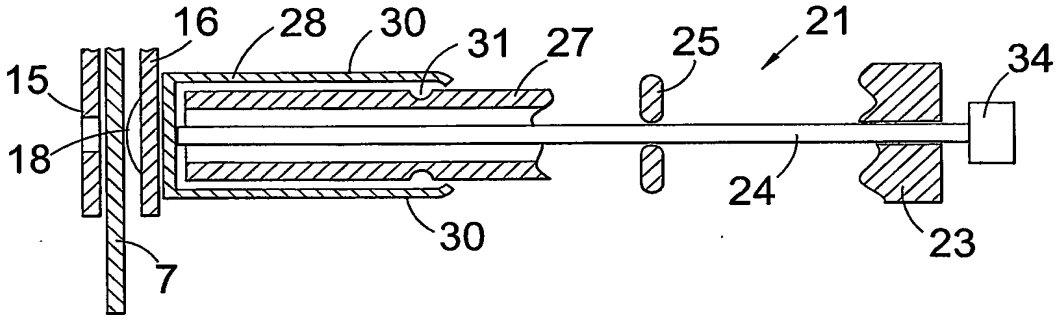

Fig. 4

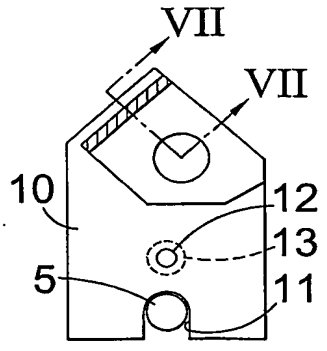

Fig. 5

Fig. 6

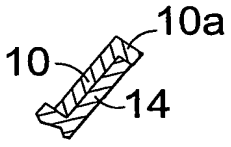

Fig. 7

INTERNATIONAL SEARCH REPORT

Internati ...plication No
PCT/GB 03/03651

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 A62C2/12 A62C2/...

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 A62C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)
EPO-Internal, WPI Data, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 958 687 A (NAKAGAWA KATSUYOSHI) 25 September 1990 (1990-09-25) the whole document	1-43
A	GB 2 255 014 A (JACKSON INT PTY LTD) 28 October 1992 (1992-10-28) the whole document	1-43
A	US 4 559 867 A (BAILEY WILLIAM J ET AL) 24 December 1985 (1985-12-24) the whole document	1-43
A	US 4 625 626 A (AALTO ERKKI ET AL) 2 December 1986 (1986-12-02) the whole document	1-43

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☒ Patent family members are listed in annex.

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17 October 2003	27/10/2003

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